it would be particularly bad where used as a help to the usual firing method, as it might make the ground so soft as to render refilling of the pots a very difficult operation. In the case, too, of most of the growers in southern California the water supply would be too uncertain, as here we irrigate for only a couple of days in each month and the stream is then passed on to the next ranch; in seasons when there is rain enough to warrant it the water is shut off completely during the winter months—as it is now [in February] in this district.

Above all, it would seem that in a paper on frost prevention the reader should be constantly warned to be ready—or, better yet, to be ready for frost at any time. Every one should be made to understand that conditions change in a very short time and that a fine springlike day may be followed by a cold night. No one should wait for warnings or indications, but, whatever his means of protection, he should be prepared to put them in operation at any hour during any night in the cold season.

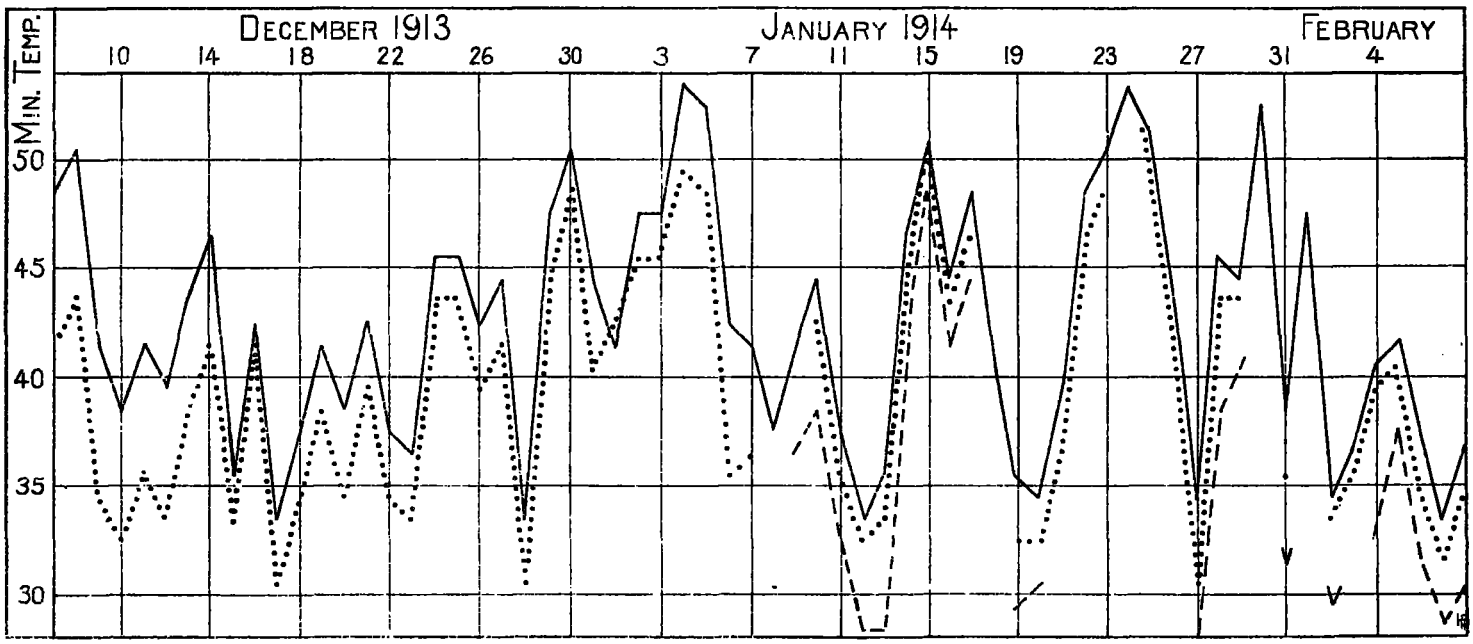

FIG. 1.—Diagram showing comparative temperatures in December, January, and February, 1913-14, at the Garthwaite ranch, Corona, Cal. (By J. W. Garthwaite, cooperative observer, Mar. 22, 1914.)
——— Thermograph record in shelter. . . . . Minimum thermometer readings in open, near shelter. - - - - - Minimum thermometer readings in the open, 100 feet from the shelter and at the bottom of an arroyo 14 feet deep.

IV.

MEMORANDUM ON AIR DRAINAGE IN THE VICINITY OF THE CORONA DISTRICT, CAL.

By FORD A. CARPENTER and J. W. GARTHWAITE.

[Dated Los Angeles, Mar. 23, 1914.]

The general effect of air drainage is noticed in the distribution of local winds during "norther" conditions. The north wind, by reason of the topography, assumes a northeasterly and later a southeasterly direction. It is locally called a "Santa Ana" for the reason that the wind is blowing down the valley (fig. 2) of the Santa Ana River. As an accompanying view (fig. 3, p. 570) shows, the first effect of the wind is shown by the formation of the dust cloud far in advance of the wind; as the wind becomes stronger and the disturbed air of greater vertical thickness, the cloud becomes general and obliterates everything. In passing, I would observe that the dry desiccating winds of the season of 1912–13 greatly damaged the citrus crop. This wind is strong and steady and apparently free from swirls or squalls.

The local effect of air drainage will be seen in the profile (fig. 1) of minimum temperature thermometers

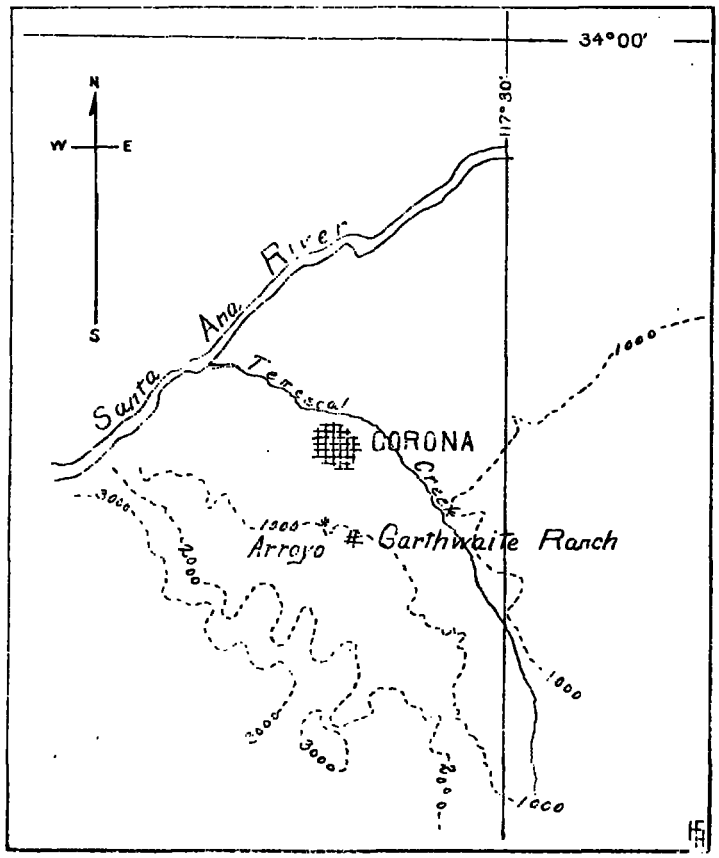

FIG. 2.—Sketch by Garthwaite, showing the topography in the vicinity of his ranch at Corona, Cal. Mount Wilson is north of Corona. Contour interval, 1,000 feet; * the arroyo mentioned in figure 1; # Garthwaite ranch.

in a standard shelter at the station, the thermometer in the open, and the thermometer in a shelter at the bottom of a neighboring arroyo (dry river bed) 14 feet below the station. The humidity that prevails during the continuance of a "norther" is shown by the chart of March 16, and the curve of observed humidity is shown by the hygrogram of March 16–20, 1914. Mr. Garthwaite tells me that he has observed the varying currents of wind in the early morning, when smudge fires were first started, to follow the contours in a most accurate way. He is constructing a delicate wind register so as to show the relative direction and force of the wind in the arroyo and at his station. If it were feasible, it might seem advisable to furnish the cooperative observer two anemometers and a register on which would be recorded both the station and the arroyo winds. Another thermograph for use in the arroyo would also give interesting and instructive results.

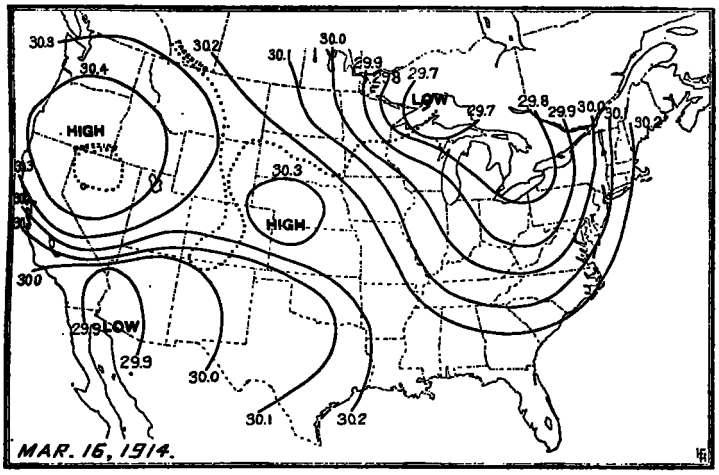

FIG. 4.—

LOS ANGELES, CAL., MONDAY, MAR. 16, 1914.

FORECAST TILL 5 P. M. TUESDAY.

For Los Angeles and vicinity: Fair to-night and Tuesday. Moderate northerly to north easterly winds.
For California, south of the Tehachipi: Fair to-night and Tuesday.

WEATHER CONDITIONS.

The barometric pressure continues high from Oregon and Washington southeasterly to Florida, and fair weather and moderate temperatures prevail throughout the greater portion of the United States. A moderate southwesterly gale is in progress at Buffalo.

We are entering on the fourth consecutive week without storms on the Pacific slope. The barometer remains high in the Northwest and moderately low in the valley of the Colorado. This considerable difference in pressure conditions will bring about marked "norther" weather during the ensuing 36 hours. Warning of moderate to strong northerly and northeasterly winds was sent by wireless to Avalon this morning at 6:50. The weather will continue fair and dry in Los Angeles and vicinity to-night and Tuesday, with moderate northerly and northeasterly winds.

Special California reports.

Orchard readings.

Stations.	Weather.	Temperature.		Precipitation.	
		Highest yesterday.	Lowest last night.	Daily.	Seasonal to date.
Pasadena	Clear	83	50	0.00	31.77
Pomona	Clear	77	43	.00	25.56
Redlands	Clear	82	50	.00	15.59
Riverside	Clear	79	48	.00	12.51
San Bernardino	Clear	83	45	.00	17.20
Santa Barbara	Clear	68	46	.00	29.58

FORD A. CARPENTER, *Local Forecaster.*

[NOTE BY F. A. C.]

Fishing fleet obeyed warnings and were safely anchored hours before the "norther" began to blow.

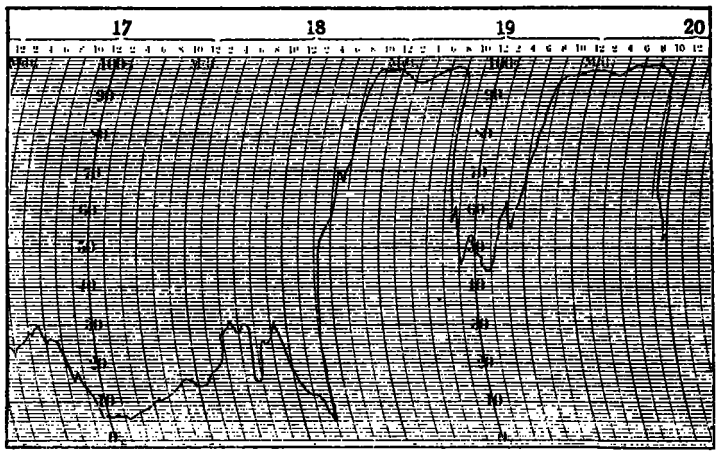

FIG. 5.—Hygrogram at Claremont, Pomona, Cal., March 16–20, 1914. "Norther" humidity conditions are shown by the above record for the 17th and 18th, while the normal curve is shown on the 19th and 20th. The hygrograph was in excellent condition and tested at the beginning of the month; the records may be relied on to within 4 or 6 per cent. At 4 p. m. of the 18th the relative humidity was 5 per cent, but within four hours the humidity rose to 97 per cent as the effect of the cessation of "norther" conditions.

V.

FROST WARNINGS AND ORCHARD HEATING IN OHIO.

By J. WARREN SMITH, Professor of Meteorology.

[Dated Weather Bureau, Columbus, Ohio, Nov. 4, 1914.]

(*a*) Introduction; (*b*) Orchard heating in 1913; (*c*) Fruit-frost stations in 1914; (*d*) Frost warnings issued, 1914; (*e*) The results of orchard heating in 1914; (*f*) Different methods of heating orchards; (*g*) Oil heaters; (*h*) Coal heaters; (*i*) Wood fires; (*k*) Temperatures dangerous to fruit buds; (*l*) When to expect frost; (*m*) Dates of blossoming of fruits; (*n*) Predictions of frost and minimum temperature; (*o*) Frost conditions vary; (*p*) Differences in minimum temperatures; (*q*) Daily range in temperature; (*r*) Predicting minimum temperatures from dew point; (*s*) Diurnal temperature changes; (*t*) Typical thermograph curves, May 11–18, 1914; (*u*) Predicting minimum temperatures from median; (*v*) Rules for predicting minimum from median temperature; (*w*) Suggestions to fruit growers in predicting minimum temperatures from the median; (*x*) Instruments to be used; (*y*) Prospective extension of this service.

(*a*) *Introduction.*—For a number of years the writer has been urging the practicability in Ohio of protecting orchard and garden crops from frost damage by smudging and heating. Within the past few years quite a number of the most progressive fruit growers of the State have taken up the matter of frost protection in a serious manner.

Warnings of general frosts have been widely distributed by telegraph and telephone, but it has seemed desirable to give more specific information as to the probable severity of the frost and the probable minimum temperature in the orchards or sections of the State where orchard heating has been taken up.

Therefore, in 1912, we began the organization of a special fruit-frost service in Ohio and in the spring of 1913 had special stations in complete operation at Delaware and Toboso, and in partial operation at a few other points.

It was estimated that the special warning service and the work of orchard heating about Delaware, Ohio, saved the fruit growers in that vicinity some $35,000 or $40,000 during the severe freeze in May, 1913.

(*b*) *Orchard heating in 1913.*—In Table 1 the result of some of the orchard heating as done in 1913 and in a few previous years is given. The notes following the table give additional information as to heaters used, fuel, mistakes in having insufficient fuel, discouragements, etc.